*Tennyson and his Friends.* Edited by Hallam Lord Tennyson. Pp. xiii+503. (London: Macmillan and Co., Ltd., 1911.) Price 10*s*. net.

THIS interesting collection of articles and reminiscences, nearly all by the personal friends of the late Lord Tennyson, and brought together by his son, will be a valuable addition to the Tennyson literature.

The book may be looked upon as a supplementary volume to the Memoirs, which appeared about four years after his death, for it gives a still further insight into the life, friendships, and opinions of the great poet.

A description is given of the early days in Lincolnshire and of the Somersby friends; also of his two brothers, Frederick and Charles, who were nearest him in age, and with whom he was most closely associated in school and college days.

Other articles give his intercourse with Lushington, Fitzgerald, Carlyle, Thackeray, Clough, and many others.

Tennyson's attitude towards science is shown in articles by Sir Norman Lockyer and Sir Oliver Lodge. The former points out "his unceasing interest in the causes of things, and in the working out of nature's laws," and compares him with Dante in this respect, more especially in the way he kept abreast of his time.

To the articles, some of which are reprints, are added several of the poems written by Tennyson to his Cambridge friends and to those of later years. The collecting into one volume of these many writings of interest cannot fail to give pleasure to all his admirers.

## LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

### Microscope Stands.

THE discussion on microscope stands will do little good if it is directed towards the production of a universal type of instrument. As a maker of microscopes, I come into close contact with many branches of work the requirements of which are totally different. To make but one form would be a fatal mistake. The metallurgist cannot use the instrument which is best suited for the bacteriologist, neither will the Rosenhain metallurgical microscope suit the biologist. The Dick petrological microscope is quite unsuitable for the entomologist, and the binocular instrument, which demands long tubes and a great range of focus for the use of the lowest powers, will not satisfy the chemist. For the use of botanists, zoologists, and bacteriologists there is a certain similarity of requirements, but even here it would be unwise to endeavour to make all microscopes on one model. The work of the student in the botanical laboratory is totally different from that of the research worker who is making photomicrographs with the highest power immersion lenses.

The development of the microscope in the future will probably be in the direction of producing specialised types for specific work. Thus discussion on microscopes in general rather than of definite types is difficult, and is liable to become discursive. It can also only be misleading to set up a false comparison between English and Continental types. No such types exist at the present time.

English microscopes are made which are almost facsimiles of instruments of Continental manufacture, and although Continental makers were slow to realise the advantages of the more perfect adjustments provided from the earliest days in English microscopes, they have commenced to do so. The so-called Continental mechanical stage was invented by John Mayall, and placed on the market by at least three British firms before it was applied to foreign microscopes, and therefore the terms English and Continental have no meaning as describing types of instruments. A few questions which apply to all microscopes may be discussed generally, but the more definite points must be considered in connection with the branch of work for which the instrument is required.

The comparison of rigid as against spring fittings for the adjustments applies to all classes of the instrument, and a full discussion of this point can, in my opinion, only lead to one conclusion. The microscope must, above all things, have adjustments which are rigid and free from spring or tremor. They must be absolutely firm, and yet must respond to the slightest movement without either backleash or sag. The adjustments consist of metal slides worked by a screw, either direct or by means of a lever or cam, or by a rack and pinion. For the fine adjustment the sliding portion must be kept up to its work by a spring to prevent backleash. The slides or fittings of a microscope must be the very finest that skill can create, and to secure this they must fit throughout their entire length or the greater portion, and not at a few small points; being scraped or ground, so that the whole of the surfaces bed together; thus only can a perfectly rigid slide free from swerve, backleash, and tremor be obtained. If this is done, the wear that takes place during many years' constant use will be quite inappreciable, as there is no load on such fittings. The provision of spring pieces to take up wear is not only unnecessary, but injurious, because once such spring pieces come into play, the fittings will henceforth depend on the friction at a few points instead of a large surface.

Such fittings are not stiff, and become loose because they bear at a few points only, and are held up by screws which are liable to shake loose. It may be argued that if the slides were fitted accurately and the spring pieces were inoperative, only being there for use in case of wear, an advantage would be gained. That is not done in practice, for if the screws holding the spring pieces of a slide so made are released, it will be found to be quite loose. Moreover, it requires a skilled workman to set up the slide of a slow motion fitted with such spring pieces to obtain a perfect motion free from backleash or sag, and it is much better that he should refit the original well-fitted slides. Spring fittings are mechanically wrong for this purpose. Who would think of having an adjustable spring fitting for a theodolite centre? The quality of the adjustments, more especially the fine adjustment, has scarcely been alluded to, but this is the most important adjustment of the instrument. I am of opinion that the original form of a micrometer screw and a lever has never been equalled by the more elaborate cams recently introduced. The smaller the number of parts that go to make the mechanism, the fewer the points of contact or bearings to give that slight sag at the reversal of the motion which makes it so difficult to obtain the best focus with high powers.

As to the form of a microscope, its stability does not depend upon whether the base is of the tripod or so-called horseshoe pattern. It is universally admitted that it should stand on three points, and the test of stability that should be applied is, at what angle will it upset, and what force is required to make it do so.

Some tripods are more unsteady than some of the horseshoe-pattern stands, and *vice versâ*. It is merely a question of the position of the three points on which the instrument stands compared with its centre of gravity and weight. As probably nine-tenths of the small compact microscopes sold are of horseshoe and pillar pattern, it may be concluded that an overwhelming opinion exists in favour of this type for ordinary botanical and medical work. This is probably because the substage is rendered more accessible, and the stability produced by a heavy base is preferred in a compact instrument to that obtained by a lighter stand with a greater spread to the feet, which also occupies a larger space. The large tripod base as supplied on some of the best research microscopes is probably the most perfect stand for stability, but the lateral legs are more or less in the way of the manipulation of substage apparatus. The design of the mechanical stage is an illustration of the necessity of specialised stands for different classes of work. If the mechanical stage is incorporated in the instrument its travel is greatly limited, as it fouls the condenser or the large illuminating

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apparatus required for dark-ground illumination. No one who works with serial slides or large blood films can put up with the small amount of motion which suffices for examining a minute drop of fluid. The examination of large culture plates is also difficult if the mechanical stage is not removable. Mr. Barnard has pointed out that the adjustable object-glass holders cannot, and are not intended to, replace the centring adjustment of the substage condenser. Such a suggestion surely originated from one who had never tried to centre his light in this manner. The centring of the substage condenser is considered by many at the present time to be an unnecessary refinement, and for those who are content to use such a badly corrected appliance as the so-called Abbe condenser it may be so. It is to be hoped that the proper use of a well-corrected achromatic condenser will be more widely appreciated in the near future, and we shall hear less criticism of the so-called dilletanti to whose labours the perfection of the instrument is largely due.

Amongst the minor points that have been raised, I noted with interest the suggestion that the mirror should be fixed in the optic axis. No doubt the mirror is seldom, if ever, used out of the axis, but it should not be overlooked that to be able to swing it entirely to one side for changing the apparatus in the substage or for taking the illumination direct from the source of light is a great convenience. It is rather surprising to see such stress laid upon a large body-tube as preventing internal reflections. I know of no optical instrument in which a large tube is supplied for this purpose, for the very good reason that the reflections are much more efficiently stopped by a series of diaphragms in the tube. There is no virtue in a large body-tube when it has within it a small draw-tube extending almost its whole length. The object of the large tube is to enable low-power photographic lenses to be placed in it when wide-angled views of large objects are required, the draw-tube at one end and the nosepiece at the other being removed for the purpose.

As an English manufacturer I am not prepared to discuss the opinion that is said to exist in some quarters that Continental instruments are more suitable to scientific needs than those made in our own country. I would merely ask that if any hold this opinion they will patriotically assist the industry by letting the British maker have an exact specification of their requirements, and I believe they will find us at least as adaptable as any in meeting their wants.

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I HAVE read with much interest the letter from Mr. Barnard on the above subject, which appeared in NATURE of January 25. Being the writer of the third section of the article which appeared in NATURE of December 21, I should like to reply to several points raised by Mr. Barnard contradicting some of my statements.

In the first place, it must be mentioned that Mr. Barnard takes certain statements as inferring far more than they are meant to, or do, imply.—There is nothing in my statements to imply "that the present-day English microscope is a degenerate form of what was originally a complicated and massive piece of mechanism." I stated it was a *simplified* form of its predecessors—a virtue indeed, therefore an advantage over the old English type.

I still maintain that the Continental instrument, having evolved from an exceedingly simple design, is a more highly satisfactory instrument. It is obvious that Continental makers have copied many ideas from the English, but it is equally obvious that the English makers have copied the Continental in many respects. If we compare the current catalogues of the principal makers in all countries where microscopes are constructed, it would be exceedingly difficult to define nationality in regard to design. Perhaps the least said respecting the country of origin the less likely one is to offend possible feelings of patriotism. The subject before us, however, is the question as to whether the English or the Continental microscopes are the superior, and in the article referred to I have dealt with the instruments as they are generally produced at the present day.

As regards the base, it is generally admitted that the horseshoe form is more convenient for the average worker than is the tripod, mainly on account of his having to employ the instrument more frequently in the vertical position; therefore a well-designed horseshoe, or modified horseshoe, as is generally found in the leading Continental stands, serves the purpose equally as well as the tripod. Only when the instrument is placed in the horizontal position does the tripod prove superior as regards rigidity.

The microscope is very rarely used horizontally, excepting in photomicrography, a work which does not concern the average microscopist; consequently, the greater rigidity in the tripod base is of no practical advantage. In other words, it is similar to making a 40-foot ladder to reach a height of 20 feet. Even when the microscope is considered for photomicrography, there is no practical advantage in the tripod over the horseshoe. (In the term horseshoe, I wish it to be understood that the models which Mr. Barnard mentions as having no rigidity or firmness in any position are excluded from the argument.) If the tripod base is not screwed or clamped to the photomicrographic apparatus, or held in position by other means, it cannot possibly remain in proper alignment for any length of time. Having occasion to use both the horseshoe and the tripod base in photomicrography, I fail to find any difference in respect to rigidity when the stand is securely fixed in position. When vibration was purposely set up I failed to observe it less in evidence in the microscope with the tripod base.

In the case of the tripod, I have it securely fixed in position by three carefully fitted recesses in the base-plate of the photomicrographic apparatus, and when the microscope is removed for visual work it can be easily and quickly returned to position for a photographic record to be made. On the other hand, the horseshoe base is securely clamped down on the base-plate, and thereby the two pieces of metal form, as it were, a solid mass. Provision is also made for quickly and accurately replacing the horseshoe upon the photomicrographic apparatus.

If the instrument built upon a horseshoe base was constructed of light or springy material, I could understand Mr. Barnard's contention that "the instrument is under considerable strain and tension."

In regard to the substage and the question of centring condenser *versus* centring objectives, Mr. Barnard's remarks amount to an admission as to the imperfect construction of the instruments he has employed. Such remarks would cause a careless or otherwise incapable mechanician to heave a sigh of relief in the expectation of the inferior workmanship that would evidently be accepted. The statement refuted by Mr. Barnard is that greater accuracy is obtained, especially in photomicrography, by having centring screws controlling the objectives instead of the substage condenser.

I cannot look upon the substage condenser of a microscope as being "an independent optical system carried on a separate part of the instrument and extremely difficult to ensure accurate alignment," but rather that it forms part of the system. In the best Continental instruments the dove-tail groove carrying the substage is formed out of the solid metal which constitutes the limb; that is to say, the limb of the microscope supporting the body-tube, coarse and fine adjustments, is carried down below the stage, and also supports the stage and substage fittings, therefore, is made out of a solid piece of brass giving the utmost strength and rigidity. When it is possible for the mechanician to provide accurate alignment in the body-tube for the highest power objectives, surely, then, it is less difficult to provide substage mechanism to carry a condenser, "even of the finest construction, which does not focus within such narrow limits." Continental microscopes are provided with substage mechanism in accurate alignment, and maintain alignment equally as well as the mechanism carrying the body-tube. Considering that condensers do not focus within such narrow limits as objectives, it is a less difficult task to adapt a series of condensers to the optic axis. Consequently, the substage condenser and the eyepiece become two fixed points in the optic axis of the microscope. As the leading makers provide objectives so well centred that the differences are but slight, the adjustments in the objective sliders effect all that is necessary to obtain the most accurate centration,

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